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ASYMETRICALLY CONTOURED ELASTOMERIC DISK

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STATEMENT OF GOVERNMENT INTEREST

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BACKGROUND OF THE INVENTION

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(1) Field of the Invention

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The present invention relates to a device for use in an elastomeric vehicle launching system, and more particularly to an elastomeric disk for the storage of elastic energy convertible to impulse fluid energy with the impulse fluid capable of ejecting or launching vehicles from the system into a liquid medium.

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(2) Description of the Prior Art

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Impulse fluid flows are used to launch vehicles from submarine platforms. Elastomeric ejection systems have been developed which store impulse fluid in a charged elastomeric bladder or against the pressure surface of a distended elastomeric disk. In the operation of an ejection system with

1 an elastomeric disk, a recharge pump of the system draws water
2 from the ocean such that the inflow of water has a pressure that
3 distends or expands the disk. The elastic deformation of the
4 disk by expansion results in a storage of energy by the disk.
5 Once a predetermined amount of energy is stored, the recharge
6 pump is shut off.

7 In order to launch a vehicle, a slide valve for the
8 designated torpedo tube is opened. The opening action of the
9 slide valve allows instantaneous porting water from the expanded
10 disk to the torpedo tube with the porting water pressure capable
11 of launching weapons from the tube.

12 Typical disks used for elastomeric ejection systems have a
13 flat, ellipsoidal, spherical, or other symmetrically contoured
14 shape. The purpose of a symmetrical contoured shape is to
15 distribute strain energy across the disk during expansion. For
16 example, the prior art disk 2 shown in FIG. 1 and shown in the
17 cross-sectional view of FIG. 2 has a symmetrical contour about a
18 central plane 4. When the prior art disk 2 expands, as shown in
19 FIG. 3, the expansion of the disk 2 outward is the greatest at
20 the center axis 6 of the disk 2. The disk 2 must be clamped or
21 attached at its edges 8, 10 to the supporting structure 12 in
22 order to expand outward.

23 The problem with the clamping of the disk 2 to the
24 supporting structure 12 is that the expansion of the disk

1 consequently puts a significant material strain at the periphery
2 of the disk 2. While there is a contact strain with the
3 supporting structure 12, the material strain is greater on the
4 pressure surface 14 of the disk 2 specifically at the point 16
5 where the disk 2 bends toward deformation of the disk. This
6 material strain at the bend of the disk 2 significantly
7 increases the risk of disk failure during operation and
8 interferes with the distribution of material strain across the
9 disk 2. In addition, the variation in the clamping strength of
10 the supporting structure 12 and the loss of material strength of
11 the disk 2 at the structure 12 makes it difficult to predict how
12 many cycles of operation the disk 2 can safely withstand.

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SUMMARY OF THE INVENTION

15 Accordingly, it is a general purpose and primary object of
16 the present invention to provide an elastomeric disk resistant
17 to cyclic material failure at its periphery.

18 It is a further object of the present invention to provide
19 an elastomeric disk in which the peak material strain levels of
20 the disk are located proximate to the center of the disk such
21 that the cycles of operation for the disk can be adequately
22 determined.

1 It is a still further object of the present invention to
2 provide an elastomeric disk which securely attaches to the
3 structure of an elastomeric ejection system.

4 To attain the objects described there is provided an
5 elastomeric disk with a thickened curvature protruding from both
6 sides of a central plane of the disk. Integral to each
7 curvature of the disk is an annulet which dovetails from the
8 curvatures to a periphery of the disk. The annulet allows
9 secure attachment of the disk to the ejection system preferably
10 by a clamp of the supporting structure of the ejection system.

11 In contrast to the prior art, the contour of the disk is
12 asymmetrical at the periphery of the disk. Specifically, the
13 thickness of the annulet in regard to the central plane is
14 greater on the pressure side of the disk. By increasing the
15 thickness of the annulet on the pressure side of the disk, the
16 bending strain and resultant material strain on the disk caused
17 by expansion is compensated for while the holding action of the
18 clamp is maintained. The strengthening of the disk thereby
19 lengthens the material cyclic life of the ejection system since
20 fatigue problems associated with the material strain at the
21 periphery bend are minimized. In addition, the reduction of
22 material strain at the periphery has the result of relocating
23 the higher material strain away from the clamp and towards the
24 center axis of the disk. At the center portion of the disk,

1 incidence of fatigue failure is generally expected and thus a
2 fatigue failure becomes more predictable for maintenance
3 scheduling.

4 The above and other features of the invention, including
5 various and novel details of construction and combinations of
6 parts will now be more particularly described with reference to
7 the accompanying drawings and pointed out in the claims. It
8 will be understood that the particular devices embodying the
9 invention are shown by way of illustration only and not as the
10 limitations of the invention. The principles and features of
11 this invention may be employed in various and numerous
12 embodiments without departing from the scope of the invention.

14 BRIEF DESCRIPTION OF THE DRAWINGS

15 A more complete understanding of the invention and many of
16 the attendant advantages thereto will be readily appreciated as
17 the same becomes better understood by reference to the following
18 detailed description when considered in conjunction with the
19 accompanying drawings wherein:

20 FIG. 1 depicts a plan view of a prior art elastomeric disk;

21 FIG. 2 depicts a cross-sectional view of the prior art
22 elastomeric disk in which the disk is clamped to the support
23 structure of an elastomeric ejection system with the view of the
24 disk taken from reference line 2-2 of FIG. 1;

FIG. 3 depicts a cross-sectional view of the prior art disk of FIG. 1 in which the disk is in an expanded state;

FIG. 4 depicts a plan view of an elastomeric disk of the present invention;

FIG. 5 depicts a cross-sectional view of the disk of the present invention with the view taken from reference line 5-5 of FIG. 4;

FIG. 6 depicts a cross-sectional view of the disk of the present invention in which the disk is clamped to the support structure of an elastomeric ejection system; and

FIG. 7 depicts a cross-sectional view of the disk of the present invention in which the disk is in an expanded state.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings including those drawings provided in the prior art portion of this specification wherein like numerals refer to like elements throughout the several views, one sees that FIG. 4 depicts the elastomeric disk 20 of the present invention. As shown in the cross-sectional view of FIG. 5, the elastomeric disk 20 is formed with a first curvature 22 protruding from a first side of a central plane 24 and a second curvature 26 protruding from a second side of the central plane 24. Integral to the curvatures 22 and 26 is an annulet 28

1 which dovetails from the taper of the curvatures 22, 26 to a
2 periphery 30 of the disk 20.

3 As further shown in the figure, the contour of the disk 20
4 is asymmetrical to the central plane 24 at the annulet 28 of the
5 disk 20. In order to compensate for bending strain associated
6 with attachment to the structure of an ejection system, the
7 thickness of the annulet 28 on the pressure surface 32 is
8 increased. The portion of the annulet 28 on the pressure side
9 32 originates at a point 33 with the point 33 located a distance
10 "A" from a center axis 34 of the disk 20. The distance "A" is
11 approximately eighty percent of the distance "B" for the point
12 35 upon which the annulet 28 originates on the non-pressure
13 surface 36 of the disk 20. By originating at the shorter
14 distance of "A", the annulet 28 incorporates a thicker area of
15 the first curvature 22.

16 In order to reduce the amount of material used while
17 maintaining an increased thickness of the annulet 28, the
18 pressure surface 32 of the annulet 28 indents toward the central
19 plane 24 without indenting the thickness of the annulet 28
20 between the origination points 33 and 35. The indent 37 is
21 preferably positioned at a majority of the distance to the
22 periphery 30 from the origination point 33. For the remaining
23 distance to the periphery 30, the pressure surface 32 extends

1 away from the central plane 24 to form the widened base 38 of
2 the annulet 28.

3 As shown in FIG. 6, the dovetailed shape of the annulet 28
4 still permits clamping by a clamp 39 at the contact area 40
5 while an arc of clamping by the clamp 39 is maintained on the
6 non-pressure surface 36 at the contact area 42. The result of
7 the increased thickness of the annulet 28 is that the bend area
8 44 shown in FIG. 7 diverts to the center axis 34 and the annulet
9 28 is also retained with minimal movement in the clamp 39. As
10 such, a shift of material strain continues to the central axis
11 34 of the disk 20.

12 Accordingly, the shift of material strain to the center of
13 the disk 20, also shifts the strain to where a fatigue failure
14 is generally expected and thus a fatigue failure becomes more
15 predictable for maintenance scheduling.

16 Thus by the present invention its objects and advantages
17 are realized and although preferred embodiments have been
18 disclosed and described in detail herein, its scope should be
19 determined by that of the appended claims.